4.7.11. TCAP Messages per Transaction

Definition: The number of Transaction Capabilities Application Part (TCAP) messages required per Service Control Point (SCP) database query. A TCAP message is a message between a switch and a database that is necessary to provide the switch with additional information prior to setting up a call or completing a call.

Default Value:

TCAP Messages per Transaction
2

Support: AT&T Updated Capacity Cost Study.[47]

4.7.12. TCAP Message Length, Bytes

Definition: The average length of a TCAP message.

Default Value:

TCAP Message Length
100 bytes

Support: Bellcore Technical Reference TR-NWT-000317, Appendix A, shows that 100 bytes per message is a conservatively high figure. Northern Telecom's DMS-STP product/service information booklet shows an average TCAP message length of 85 bytes.[48]

4.7.13. Fraction of BHCA Requiring TCAP

Definition: The percentage of BHCAs that require a database query, and thus generate TCAP messages.

Default Value:

Fraction of BHCA Requiring TCAP
0.10

Support: The AT&T Updated Capacity Cost Study assumes that 50% of all calls require a database query, but that is not an appropriate number to use in the HM because a substantial fraction of IXC calls are toll-free (800) calls.[49] When reduced to reflect the fact that a large majority of calls handled by the LECs are local calls that do not require such a database query, the 50% would be less than 10%; HAI has used the 10% default as a conservatively high estimate.

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[47] Brand, et al., *"An Updated Study of AT&T's Competitors' Capacity to Absorb Rapid Demand Growth"*, p. 25.

[48] DMS-STP Planner 1995, p.13.

[49] Brand, et al., *"An Updated Study of AT&T's Competitors' Capacity to Absorb Rapid Demand Growth"*, p. 25.

4.7.14. SCP Investment per Transaction per Second

Definition: The investment in the SCP associated with database queries, or transactions, stated as the investment required per transaction per second. For example, if the default of $20,000 is assumed, an SCP required to handle 100 transactions per second would require a 2 million dollar ($20,000 times 100) investment.

Default Value:

SCP Investment per Transaction, per Second
$20,000

Support: AT&T Updated Capacity Cost Study uses a default value of $30,000 from the 1990 study, but notes that this is "conservatively high because of the industry's advances in this area and the resulting decrease in technology costs since the 1990 study."[50] The default value used in the HM represents the judgment of HAI as to the reduction of such processing costs since then.

[50] Brand, et al., *"An Updated Study of AT&T's Competitors' Capacity to Absorb Rapid Demand Growth"*, p. 27.

4.8. OS AND PUBLIC TELEPHONE

4.8.1. Investment per Operator Position

Definition: The investment per computer required for each operator position.

Default Value:

Investment per Operator Position
$6,400

Support: Based on AT&T experience in the long distance business.

4.8.2. Maximum Utilization per Position, CCS

Definition: The estimated maximum number of CCS that one operator position can handle during the busy hour.

Default Value:

Maximum Utilization per Position
32 CCS

Support: Industry experience and expertise of HAI in conjunction with subject matter experts.

4.8.3. Operator Intervention Factor

Definition: The percentage of all operator-assisted calls that require operator intervention, expressed as 1 out of every N calls, where N is the value of the input. Given the default values for operator-assisted calls, this parameter means that 1/10, or 10%, of the assisted calls actually require manual intervention of an operator, as opposed to *automated* operator assistance for credit card verification, etc.

Default Value:

Operator Intervention Factor
10

Support: Industry experience and expertise of HAI.

4.8.4. Public Telephone Equipment Investment per Station

Definition: The weighted average cost of a public telephone and pedestal (coin/non-coin and indoor/outdoor).

Default Value:

Public Telephone Equipment Investment, per Station
$760

Support: New England Incremental Cost Study.[51]

[51] New England Telephone Company, *"1993 New Hampshire Incremental Cost Study"*, p. 90.

4.9. ICO PARAMETERS

4.9.1. ICO STP Investment, per Line

Definition: The surrogate value for equivalent per line investment in STPs by a small independent telephone company (ICO), that is used in lieu of calculating it directly in the model.

Default Value:

ICO STP Investment per Line
$5.50

Support: The average STP investment per line estimated by the Hatfield Model for all states, with 20 percent added to reflect the higher cost a small ICO is likely to encounter, due to its character of use.

4.9.2. ICO Local Tandem Investment, per Line

Definition: The surrogate value for the per line investment in a local tandem switch by a small independent telephone company (ICO), that is used in lieu of calculating it directly in the model.

Default Value:

Per Line ICO Local Tandem Investment
$1.90

Support: The average local tandem investment per line from the Hatfield Model, with 20 percent added to reflect the higher cost a small ICO is likely to encounter, due to its character of use.

4.9.3. ICO OS Tandem Investment, per Line

Definition: The surrogate value for the per line investment in an Operator Services tandem switch by a small independent telephone company (ICO),that is used in lieu of calculating it directly in the model.

Default Value:

Per Line ICO OS Tandem Investment
$0.80

Support: The average OS tandem investment per line from the Hatfield Model, with 20 percent added to reflect the higher cost a small ICO is likely to encounter, due to its character of use.

4.9.4. ICO SCP Investment, per Line

Definition: The surrogate value for the per line investment in a SCP by a small independent telephone company (ICO), that is used in lieu of calculating it directly in the model.

Default Value:

Per Line ICO SCP Investment
$2.50

Support: The average SCP investment per line from the Hatfield Model, with 20 percent added to reflect the higher cost a small ICO is likely to encounter, due to its character of use.

4.9.5. ICO Local Tandem Wire Center Investment, per Line

Definition: The surrogate value for the per line investment in a local tandem wire center by a small independent telephone company (ICO), that is used in lieu of calculating it directly in the model.

Default Value:

Per Line ICO Local Tandem Wire Center Investment
$2.50

Support: The average local tandem wire center investment per line from the Hatfield Model, with 20 percent added to reflect the higher cost a small ICO is likely to encounter, due to its character of use.

4.9.6. ICO OS Tandem Wire Center Investment, per Line

Definition: The surrogate value for the per line investment in a operator services tandem wire center by a small independent telephone company (ICO), that is used in lieu of calculating it directly in the model.

Default Value:

Per Line ICO OS Tandem Wire Center Investment
$1.00

Support: The average OS tandem wire center investment per line from the Hatfield Model, with 20 percent added to reflect the higher cost a small ICO is likely to encounter, due to its character of use.

4.9.7. ICO STP/SCP Wire Center Investment, per Line

Definition: The surrogate value for the per line investment in an STP/SCP wire center by a small independent telephone company (ICO), that is used in lieu of calculating it directly in the model.

Default Value:

Per Line STP / SCP Wire Center Investment
$0.40

Support: The average STP/SCP wire center investment per line from the Hatfield Model, with 20 percent added to reflect the higher cost a small ICO is likely to encounter, due to its character of use.

4.9.8. ICO C-Link / Tandem A-Link Investment, per Line

Definition: The surrogate value for the per line investment in a C-link / tandem A-link by a small independent telephone company (ICO), that is used in lieu of calculating it directly in the model.

Default Value:

Per Line ICO C-Link / Tandem A-Link Investment
$0.30

Support: The average C-Link / tandem A-link investment per line from the Hatfield Model, with 20 percent added to reflect the higher cost a small ICO is likely to encounter, due to its character of use.

4.10. HOST – REMOTE PARAMETERS

4.10.1. Host – Remote CLLI Assignments

Definition: A series of parameters that allow the user to determine the set of host and remote wire centers, and establish the relationships between remotes and their serving host.

Default Value:

Host – Remote CLLI Assignments
No host-remote relationships defined

Support: These parameters are provided to give the user the means to establish host-remote relationships.

4.10.2. Host – Remote Assignment Enable

Definition: A toggle switch that enables or disables the established host-remote relationships. In order to use host-remote features in HM 5.0, the user must establish host-remote relationships and enable the host-remote calculations.

Default Value:

Host – Remote Assignment Flag
Disabled

5. EXPENSE

5.1. COST OF CAPITAL AND CAPITAL STRUCTURE

Definition: The capital cost structure, including the debt/equity ratio, cost of debt, and return on equity, that make up the overall cost of capital.

Default Values:

Cost of Capital	
Debt percent	0.450
Cost of debt	0.077
Cost of equity	0.119
Weighted average cost of capital	0.1001

Support: Based on FCC-approved cost of capital methodology using 1996 financial data and AT&T and MCI-sponsored DCF and CAPM analyses calculating the RBOCs' cost of capital. See, for example, "Statement of Matthew I. Kahal Concerning Cost of Capital," In the Matter of Rate of Return Prescription for Local Exchange Carriers," File No. AAD95-172, March 11, 1996. See also AT&T ex parte filing of February 12, 1997, "Estimating the Cost of Capital of Local Telephone Companies for the Provision of Network Elements," by Bradford Cornell, September, 1996.

5.2. DEPRECIATION AND NET SALVAGE

Definition: The economic life of various network plant categories.

Default Values:

Plant Type	Economic Life	Net Salvage %
motor vehicles	8.24	11.21
garage work equipment	12.22	-10.71
other work equipment	13.04	3.21
buildings	46.93	1.87
furniture	15.92	6.88
office support equipment	10.78	6.91
company comm. Equipment	7.40	3.76
general purpose computers	6.12	3.73
digital electronic switching	16.17	2.97
operator systems	9.41	-0.82
digital circuit equipment	10.24	-1.69
public telephone term. Equipment	7.60	7.97
poles	30.25	-89.98
aerial cable, metallic	20.61	-23.03
aerial cable, non metallic	26.14	-17.53
underground cable, metallic	25.00	-18.26
underground cable, non metallic	26.45	-14.58
buried cable, metallic	21.57	-8.39
buried cable, non metallic	25.91	-8.58
intrabuilding cable, metallic	18.18	-15.74
intrabuilding cable, non metallic	26.11	-10.52
conduit systems	56.19	-10.34

Support: The default values are the weighted average set of projected depreciation lives, and net salvage percentages, coming from 76 LEC study areas including all the BOCs, SNET, Cincinnati Bell, and numerous GTE and United companies. Weighting is based on total lines per operating company. The projected lives and salvage values are determined in a triennial review process involving each state PUC, the FCC, and the LEC to establish unique state-and-operating-company-specific depreciation schedules. See, FCC Public Notice D.A. #'s 95-1635, 93-970, 96-1175, 94-856, 95-1712. NID and SAI lives are calculated as the average life of metallic cable, since lives are not separately specified for those plant categories and they are classified as outside plant.

5.3. STRUCTURE SHARING FRACTION

Definition: The fraction of investment in distribution and feeder poles and trenching that is assigned to LECs. The remainder is attributed to other utilities/carriers.

Default Values:

Structure Percent Assigned to Telephone Company						
	Distribution			Feeder		
Density Zone	Aerial	Buried	Underground	Aerial	Buried	Underground
0-5	.50	.33	1.00	.50	.40	.50
5-100	.33	.33	.50	.33	.40	.50
100-200	.25	.33	.50	.25	.40	.40
200-650	.25	.33	.50	.25	.40	.33
650-850	.25	.33	.40	.25	.40	.33
850-2,550	.25	.33	.33	.25	.40	.33
2,550-5,000	.25	.33	.33	.25	.40	.33
5,000-10,000	.25	.33	.33	.25	.40	.33
10,000+	.25	.33	.33	.25	.40	.33

Support: Industry experience and expertise of HAI and outside plant engineers; Montgomery County, MD Subdivision Regulations Policy Relating to Grants of Location for New Conduit Network for the Provision of Commercial Telecommunications Services; Monthly Financial Statements of the Southern California Joint Pole Committee; Conversations with representatives of local utility companies. See the structure sharing discussion in Appendix B.

5.4. OTHER EXPENSE INPUTS

5.4.1. Income Tax Rate

Definition: The composite federal and state income tax rate on earnings paid by a telephone company.

Default Value:

Income Tax Rate
39.25%

Support: Based on a nationwide average of composite federal and state tax rates.

5.4.2. Corporate Overhead Factor

Definition: Forward-looking corporate overhead costs, expressed as a fraction of the sum of all capital costs and operations expenses calculated by the model.

Default Value:

Overhead Factor
10.4%

Support: Based on data from AT&T's Form M. See, also earlier ex parte submission by AT&T dated March 18, 1997 and Appendix C.

5.4.3. Other Taxes Factor

Definition: Operating taxes (primarily gross receipts and property taxes) paid by a telephone company in addition to federal and state income taxes.

Default Value:

Other Taxes Factor
5%

Support: This is the average for all Tier I LECs, expressed as a percentage of total revenue. Revenue and tax data are taken from the 1996 ARMIS report 43-03. See, also Appendix B.

5.4.4. Billing/Bill Inquiry per Line per Month

Definition:

The cost of bill generation and billing inquiries for end users, expressed as an amount per line per month.

Default Value:

Billing / Bill Inquiry per line per month
$1.22

Support: Based on data found in the New England Incremental Cost Study, section for billing and bill inquiry where unit costs are developed. This study uses marginal costing techniques, rather than TSLRIC. Therefore, billing/bill inquiry-specific fixed costs were added to conform with TSLRIC principles.[52]

To compute this value from the NET study, the base monthly cost for residential access lines is divided by the base demand (lines) for both bill inquiry (p. 122) and bill production (p. 126). The resulting per-line values are added together to arrive at the total billing/bill inquiry cost per line per month.

5.4.5. Directory Listing per Line per Month

Definition: The monthly cost of creating and maintaining white pages listings on a per line, per month basis for Universal Service Fund purposes

Default Value:

Directory Listing per line per month
$0.00

Support: Because the FCC and Joint Board have determined that white pages listings are not an element of supported Universal Service, this value is set to default to zero. HAI estimates that the cost of maintaining a white page listing per line is $0.15 per month.

5.4.6. Forward-Looking Network Operations Factor

Definition: The forward-looking factor applied to a specific category of expenses reported in ARMIS called Network Operations. The factor is expressed as the percentage of current ARMIS-reported Network Operations costs per line.

Default Value:

Forward Looking Network Operations Factor
50%

Support: ARMIS-based network operations expenses are -- by definition -- a function of telephone company embedded costs. As reported, these costs are artificially high because they reflect antiquated systems and practices that are more costly than the modern equipment and practices that the Hatfield Model assumes will be installed on a forward-looking basis. Furthermore, today's costs do not reflect much of the substantial savings opportunities posed by new technologies, such as new management network standards, intranets, and the like. See Appendix D for a more detailed discussion of the savings opportunities associated with network operations.

[52] New England Telephone Company, *"1993 New Hampshire Incremental Cost Study"*, p. 122, 126.

5.4.7. Alternative Central Office Switching Expense Factor

Definition: The expense to investment ratio for digital switching equipment, used as an alternative to the ARMIS expense ratio, reflecting forward looking rather than embedded costs. Thus, this factor multiplies the calculated investment in digital switching in order to determine the monthly expense associated with digital switching. This factor is not intended to capture the cost of software upgrades to the switch, as all switching software is part of the capital value inputs to HM 5.0.

Default Value:

Alternative Central Office Switching Expense Factor
2.69%

Support: New England Incremental Cost Study.[53]

5.4.8. Alternative Circuit Equipment Factor

Definition: The expense to investment ratio for all circuit equipment (as categorized by LECs in their ARMIS reports), used as an alternative to the ARMIS expense ratio to reflect forward looking rather than embedded costs.

Default Value:

Alternative Circuit Equipment Factor
0.0153

Support: New England Incremental Cost Study.[54]

5.4.9. End Office Non Line-Port Cost Fraction

Definition: The fraction of the cost of switching that is associated with switch usage, as opposed to the port (non-traffic sensitive) costs.

Default Value:

End Office Non Line-Port Cost Fraction
70%

Support: This factor is a HAI estimate of the average over several different switching technologies.

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[53] New England Telephone Company, *"1993 New Hampshire Incremental Cost Study"*, p. 394

[54] New England Telephone Company, *"1993 New Hampshire Incremental Cost Study"*, p. 394

5.4.10. Monthly LNP Cost, per Line

Definition: The estimated cost of permanent Local Number Portability (LNP), expressed on a per-line, per-month basis, including the costs of implementing and maintaining the service. This is included in the USF calculations only, not the UNE rates, because it will be included in the definition of universal service once the service is implemented.

Default Value:

Per Line Monthly LNP Cost
$0.25

Support: This estimate is based on an ex parte submission by AT&T to the FCC in CC Docket No. 95-116, dated May 22, 1996.

5.4.11. Carrier-Carrier Customer Service, per Line, per Year

Definition: The yearly amount of customer operations expense associated with the provision of unbundled network elements by the LECs to carriers who purchase those elements.

Default Value:

Carrier-Carrier Customer Service per line
$1.69

Support: This calculation is based on data drawn from LEC ARMIS accounts 7150, 7170, 7190 and 7270 reported by all Tier I LECs in 1996. To calculate this charge, the amounts shown for each Tier 1 LEC in the referenced accounts are summed across the accounts and across all LECs, divided by the number of access lines reported by those LECs in order to express the result on a per-line basis, and multiplied by 70% to reflect forward-looking efficiencies in the provision of network elements. See, also Appendix C.

5.4.12. NID Expense, per Line, per Year

Definition: The estimated annual NID expense on a per line basis, based on an analysis of ARMIS data modified to reflect forward-looking costs. This is for the NID only, not the drop wire, which is included in the ARMIS cable and wire account.

Default Value:

NID Expense per line per year
$1.00

Support: The opinion of outside plant experts indicate a failure rate of less than 0.25 per 100 lines per month, or 3 percent per year. At a replacement cost of $29, this would yield an annual cost of $0.87. Therefore, the current default value is conservatively high.

5.4.13. DS-0/DS-1 Terminal Factor

Definition: The relative terminal investment per DS-0, between the DS-1 and DS-0 levels.

Default Value:

DS-0 / DS-1 Terminal Factor
12.4

Support: The computed ratio for investment per DS-0 when provided in a DS-0 level signal, to per DS-0 investment when provided in a DS-1 level signal, based on transmission terminal investments (see 4.4.1 for terminal investments).

5.4.14. DS-1/DS-3 Terminal Factor

Definition: The relative investment per DS-0, between the DS-3 and DS-1 levels.

Default Value:

DS-1 / DS-3 Terminal Factor
9.9

Support: The computed ratio for investment per DS-0 when provided in a DS-1 level signal, to per DS-0 investment when provided in a DS-3 level signal, based on transmission terminal investments (i.e., 4.4.1).

5.4.15. Average Lines per Business Location

Definition: The average number of business lines per business location, used to calculate NID and drop cost. This parameter should be set the same as 2.2.5.

Default Value:

Average Business Lines per Location
4

Support: ***{NOTE: The discussion in Section 2.2.5. [Distribution] is reproduced here for ease of use.}***

The number of lines per business location estimated by HAI is based on data in the *1995 Common Carrier Statistics* and the *1995 Statistical Abstract of the United States.*

5.4.16. Average Trunk Utilization

Definition: The 24 hour average utilization of an interoffice trunk.

Default Value:

Average Trunk Utilization
0.30

Support: AT&T Capacity Cost Study.[55]

[55] Blake, et al., *"A Study of AT&T's Competitors' Capacity to Absorb Rapid Demand Growth"*, p.4.

6. EXCAVATION AND RESTORATION

6.1. UNDERGROUND EXCAVATION

Definition: The cost per foot to dig a trench in connection with building an underground conduit system to facilitate the placement of underground cables. Cutting the surface, placing the 4" PVC conduit pipes, backfilling the trench with appropriately screened fill, and restoring surface conditions is covered in the following section titled, "Underground Restoration Cost per Foot". These two sections do not include the material cost of the PVC conduit pipe, which is covered under "Conduit Material Investment per foot", and is affected by the number of cables placed in a conduit run, and the number of "Spare tubes per Route."

Default Values:

Underground Excavation Costs per Foot						
Density	Normal Trenching		Backhoe		Hand Trench	
Range	Fraction	Per Foot	Fraction	Per Foot	Fraction	Per Foot
0-5	*54%*	$1.90	45%	$3.00	1%	$5.00
5-100	*54%*	$1.90	45%	$3.00	1%	$5.00
100-200	*54%*	$1.90	45%	$3.00	1%	$5.00
200-650	*52%*	$1.90	45%	$3.00	3%	$5.00
650-850	*52%*	$1.95	45%	$3.00	3%	$5.00
850-2,550	*50%*	$2.15	45%	$3.00	5%	$5.00
2,550-5,000	*35%*	$2.15	55%	$3.00	10%	$5.00
5,000-10,000	*23%*	$6.00	67%	$20.00	10%	$10.00
10,000+	*16%*	$6.00	72%	$30.00	12%	$18.00

Note: Fraction % for Trenching is the fraction remaining after subtracting Backhoe % & Trench %.

Support: See discussion in Section 6.2.

6.2. UNDERGROUND RESTORATION

Definition: The cost per foot to cut the surface, place the 4" PVC conduit pipes, backfill the trench with appropriately screened fill, and restore surface conditions. Digging a trench in connection with building an underground conduit system to facilitate the placement of underground cables is covered in the preceding section titled, "Underground Excavation Cost per Foot". These two sections do not include the material cost of the PVC conduit pipe, which is covered under "Conduit Material Investment per foot", and is affected by the number of cables placed in a conduit run, and the number of "Spare tubes per Route."

Default Values:

Underground Restoration Costs per Foot												
	Cut/Restore Asphalt		Cut/Restore Concrete		Cut/Restore Sod		Simple Backfill		Conduit Placement & Stabilization			
Density Range	Fraction	Per Foot	Fraction	Per Foot	Fraction	Per Foot	Fraction	Per Foot	Fraction	Pavement/ft	Fraction	Dirt/ft
0-5	55%	$6.00	10%	$9.00	1%	$1.00	34%	$0.15	65%	$5.00	35%	$1.00
5-100	55%	$6.00	10%	$9.00	1%	$1.00	34%	$0.15	65%	$5.00	35%	$1.00
100-200	55%	$6.00	10%	$9.00	1%	$1.00	34%	$0.15	65%	$5.00	35%	$1.00
200-650	65%	$6.00	10%	$9.00	3%	$1.00	22%	$0.15	75%	$5.00	25%	$1.00
650-850	70%	$6.00	10%	$9.00	4%	$1.00	16%	$0.15	80%	$5.00	20%	$1.00
850-2,550	75%	$6.00	10%	$9.00	6%	$1.00	9%	$0.15	85%	$9.00	15%	$4.00
2,550-5,000	75%	$6.00	15%	$9.00	4%	$1.00	6%	$0.15	90%	$13.00	10%	$11.00
5,000-10,000	80%	$18.00	15%	$21.00	2%	$1.00	3%	$0.15	95%	$17.00	5%	$12.00
10,000+	82%	$30.00	16%	$36.00	0%	$1.00	2%	$0.15	98%	$20.00	2%	$16.00

Note: Fraction % for Simple Backfill is the fraction remaining after subtracting Asphalt % & Concrete % & Sod %. Fraction % for Conduit Placement & Stabilization for Pavement is Asphalt % + Concrete %. Dirt is Sod % + Simple Backfill %

Support: The costs reflect a mixture of different types of placement activities.

Note: Use of underground conduit structure for distribution should be infrequent, especially in the lower density zones. Although use of conduit for distribution cable in lower density zones is not expected, default prices are shown, should a user elect to change parameters for percent underground, aerial, and buried structure allowed by the HM 5.0 model structure.

A compound weighted cost for conduit excavation, placement and restoral can be calculated by multiplying the individual columns shown above and in the immediately preceding section, "Underground Excavation Costs per Foot". Performing such calculations using the default values shown would provide the following composite costs by density zone.

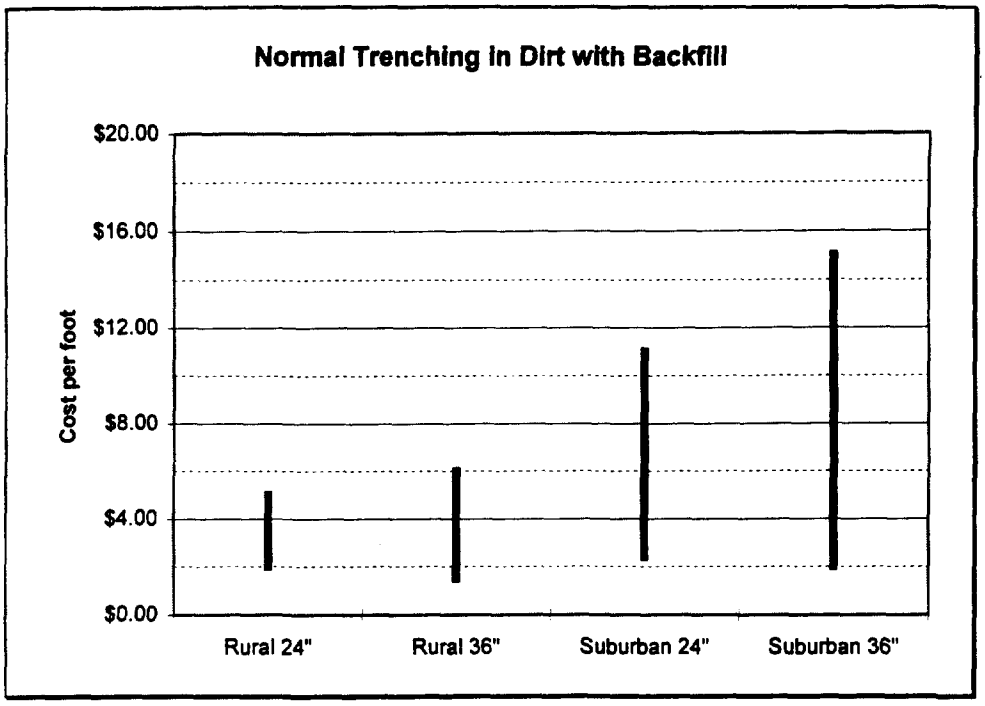
The percentages for Underground Excavation Costs total to 100%, for Restoration (Asphalt + Concrete + Sod + Simple Backfill) total to 100%, and for Conduit Placement & Stabilization total to 100%, since each is a discrete function.

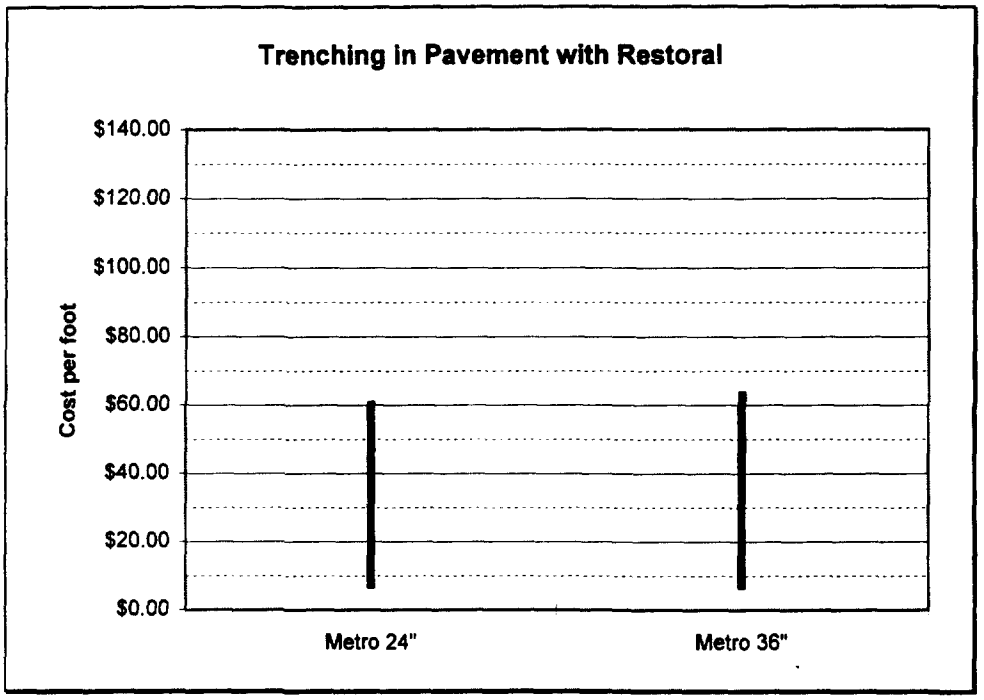
Underground Excavation, Restoration, and Conduit Placement Cost per Foot	
Density Zone	**Cost Per Foot**
0-5	$10.29
5-100	$10.29
100-200	$10.29
200-650	$11.35
650-850	$11.88
850-2,550	$16.40
2,550-5,000	$21.60
5,000-10,000	$50.10
10,000+	$75.00

Costs for various trenching methods were estimated by a team of experienced outside plant experts. Additional information was obtained from printed resources[56]. Still other information was provided by several contractors who routinely perform excavation, conduit, and manhole placement work for telephone companies. Results of those inquiries are revealed in the following charts. Note that this survey demonstrates that costs do not vary significantly between buried placements at 24" underground versus 36" underground. Therefore the Hatfield Model assumes an average placement depth ranging from 24" to 36", averaging 30".

Conduit placement cost is essentially the same, whether the conduit is used to house distribution cable, feeder cable, interoffice cable, or other telecommunication carrier cable, including CATV.

[56] Martin D. Kiley and Marques Allyn, eds., *1997 National Construction Estimator 45th Edition*, pp. 12-15.


Normal Trenching in Dirt with Backfill
$20.00
$16.00
$12.00
$8.00
$4.00
$0.00
Cost per foot
Rural 24"
Rural 36"
Suburban 24"
Suburban 36"


Trenching in Pavement with Restoral
$140.00
$120.00
$100.00
$80.00
$60.00
$40.00
$20.00
$0.00
Cost per foot
Metro 24"
Metro 36"

6.3. BURIED EXCAVATION

Definition: The cost per foot to dig a trench to allow buried placement of cables, or the plowing of one or more cables into the earth using a single or multiple sheath plow.

Default Values:

Buried Excavation Costs per Foot												
	Plow		Normal Trench		Backhoe		Hand Trench		Bore Cable		Push Pipe/Pull Cbl	
Density Range	Frac-tion	Per Foot	Frac-tion	Per Foot	Frac-tion	Per Foot	Frac-tion	Per Foot	Frac-tion	Per Foot	Frac-tion	Per Foot
0-5	60%	$0.80	28%	$1.90	10%	$3.00	0%	$5.00	0%	$11.00	2 %	$6.00
5-100	60%	$0.80	28%	$1.90	10%	$3.00	0%	$5.00	0%	$11.00	2%	$6.00
100-200	60%	$0.80	28%	$1.90	10%	$3.00	0%	$5.00	0%	$11.00	2%	$6.00
200-650	50%	$0.80	37%	$1.90	10%	$3.00	1%	$5.00	0%	$11.00	2%	$6.00
650-850	35%	$0.80	51%	$1.95	10%	$3.00	2%	$5.00	0%	$11.00	2%	$6.00
850-2,550	20%	$1.20	59%	$2.15	10%	$3.00	4%	$5.00	3%	$11.00	4%	$6.00
2,550-5,000	0%	$1.20	76%	$2.15	10%	$3.00	5%	$5.00	4%	$11.00	5%	$6.00
5,000-10,000	0%	$1.20	73%	$6.00	10%	$20.00	6%	$10.00	5%	$11.00	6%	$6.00
10,000+	0%	$1.20	54%	$15.00	25%	$30.00	10%	$18.00	5%	$18.00	6%	$24.00

Note: Fraction % for Normal Trenching is the fraction remaining after subtracting Plow %, Backhoe %, Hand Trench %, Bore Cable % and Push Pipe / Pull Cable %.

Support: See discussion in Section 6.4.

6.4. BURIED INSTALLATION AND RESTORATION

Definition: The cost per foot to push pipe under pavement , or the costs per foot to cut the surface, place cable in a trench, backfill the trench with appropriately screened fill, and restore surface conditions. Digging a trench in connection with placing buried cable is covered in the preceding section titled, "Buried Excavation Cost per Foot".

Default Values:

Buried Installation and Restoration Costs per Foot									
	Cut/Restore Asphalt		Cut/Restore Concrete		Cut/Restore Sod		Simple Backfill		Restoral Not Req'd
Density Range	Frac-tion	Per Foot	Frac-tion	Per Foot	Frac-tion	Per Foot	Frac-tion	Per Foot	Frac-tion
0-5	3%	$6.00	1%	$9.00	2%	$1.00	32%	$0.15	62%
5-100	3%	$6.00	1%	$9.00	2%	$1.00	32%	$0.15	62%
100-200	3%	$6.00	1%	$9.00	2%	$1.00	32%	$0.15	62%
200-650	3%	$6.00	1%	$9.00	2%	$1.00	42%	$0.15	52%
650-850	3%	$6.00	1%	$9.00	2%	$1.00	57%	$0.15	37%
850-2,550	5%	$6.00	3%	$9.00	35%	$1.00	30%	$0.15	27%
2,550-5,000	8%	$6.00	5%	$9.00	35%	$1.00	43%	$0.15	9%
5,000-10,000	18%	$18.00	8%	$21.00	11%	$1.00	52%	$0.15	11%
10,000+	60%	$30.00	20%	$36.00	5%	$1.00	4%	$0.15	11%

Note: Restoral is not required for plowing nor for pushing pipe & pulling cable. Fraction % for Simple Backfill is the fraction remaining after subtracting Restoral Not Required %.

Support: The costs reflect a mixture of different types of placement activities.

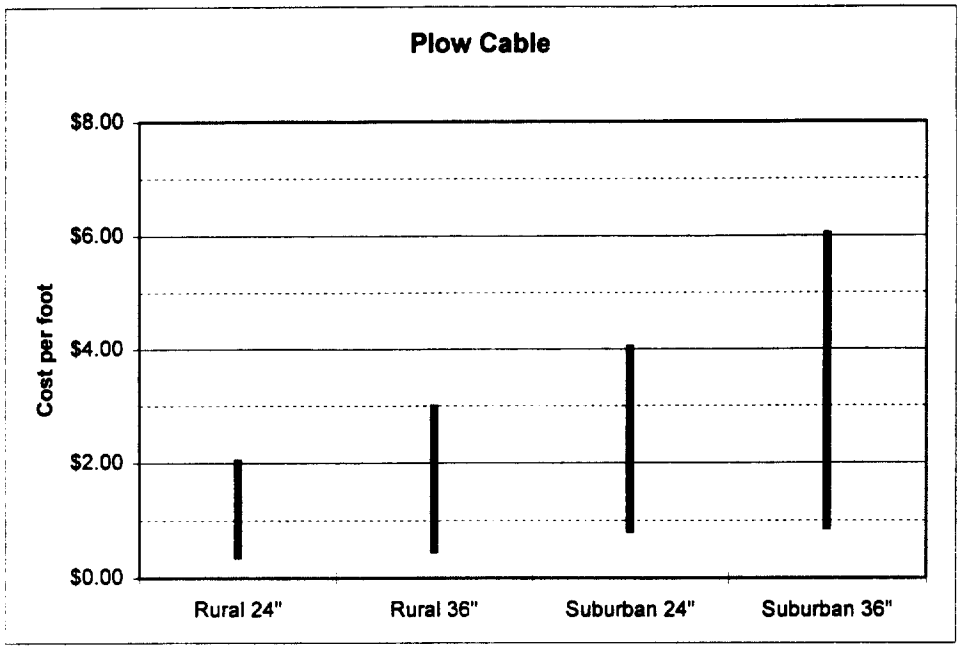
A compound weighted cost for conduit excavation, placement and restoral can be calculated by multiplying the individual columns shown above and in the immediately preceding section, "Buried Excavation Costs per Foot". Performing such calculations using the default values shown would provide the following composite costs by density zone.

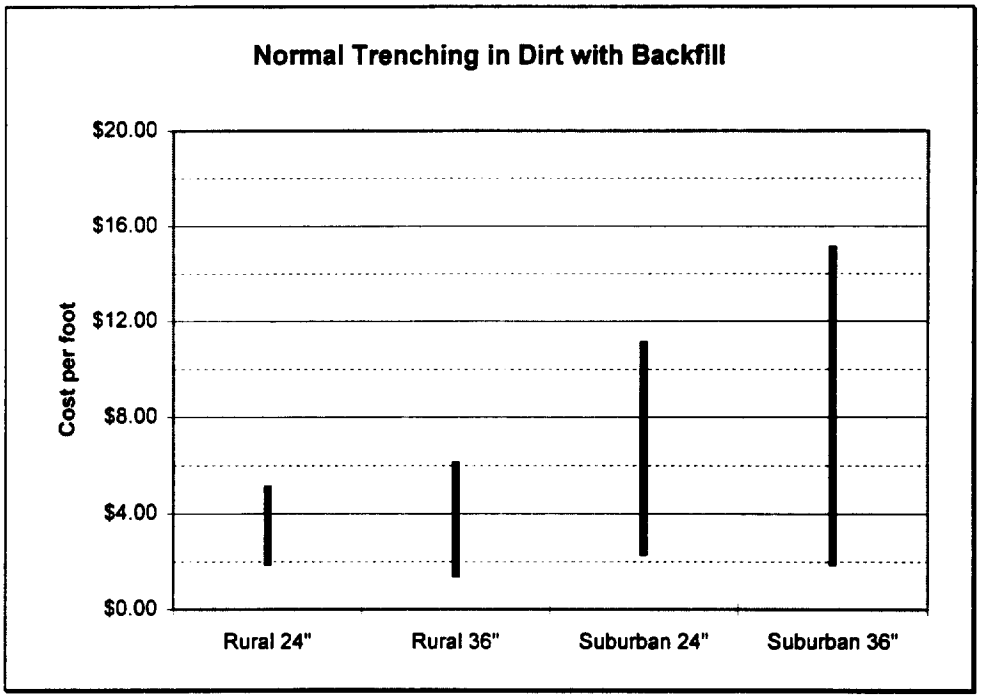
Buried Excavation, Installation, and Restoration Cost per Foot	
Density Zone	Cost Per Foot
0-5	$1.77
5-100	$1.77
100-200	$1.77
200-650	$1.93
650-850	$2.17
850-2,550	$3.54
2,550-5,000	$4.27
5,000-10,000	$13.00
10,000+	$45.00

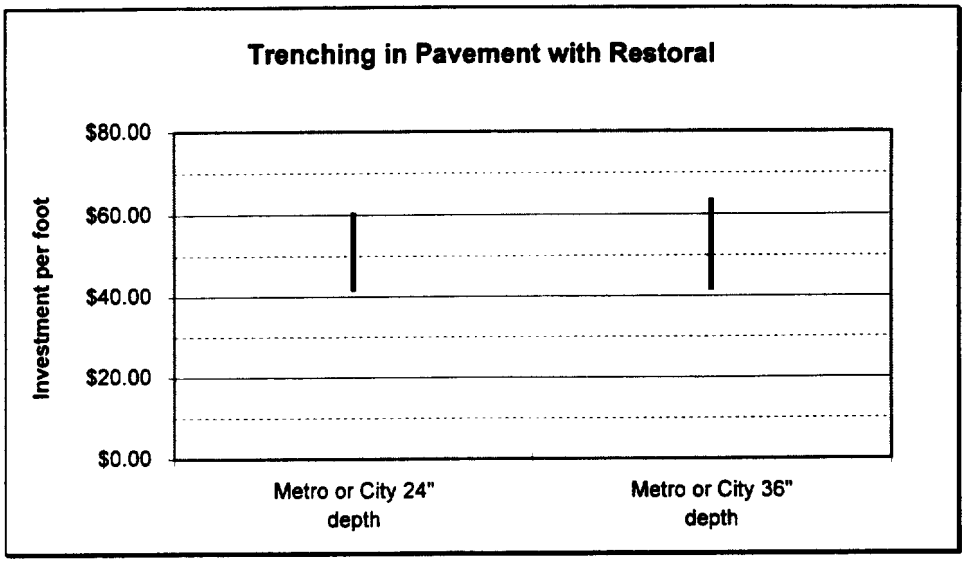
Costs for various excavation methods were estimated by a team of experienced outside plant experts. Additional information was obtained from printed resources[57]. Still other information was provided by several contractors who routinely perform excavation, conduit, and manhole placement work for telephone companies. Results of those inquiries are revealed in the following charts. Note that this survey

[57] Martin D. Kiley and Marques Allyn, eds., *1997 National Construction Estimator 45th Edition*, pp. 12-15.

demonstrates that costs do not vary significantly between buried placements at 24" underground versus 36" underground. Therefore the Hatfield Model assumes an average placement depth ranging from 24" to 36", averaging 30".






Trenching in Pavement with Restoral
Investment per foot
$80.00
$60.00
$40.00
$20.00
$0.00
Metro or City 24" depth
Metro or City 36" depth

6.5. SURFACE TEXTURE MULTIPLIER

Definition: The increase in placement cost attributable to the soil condition in a CBG, expressed as a multiplier that applies to any buried or underground structure excavation component in the CBG. The table lists effects in alphabetical order by Texture Code.

Default Values:

Fraction CBG Affected	Effect	Texture	Description of Texture
1.00	1.00		Blank
1.00	1.00	BY	Bouldery
1.00	1.00	BY-COS	Bouldery Coarse Sand
1.00	1.00	BY-FSL	Bouldery & Fine Sandy Loam
1.00	1.00	BY-L	Bouldery & Loam
1.00	1.00	BY-LS	Bouldery & Sandy Loam
1.00	1.00	BY-SICL	Bouldery & Silty Clay Loam
1.00	1.00	BY-SL	Bouldery & Sandy Loam
1.00	1.10	BYV	Very Bouldery
1.00	1.10	BYV-FSL	Very Bouldery & Fine Sandy Loam
1.00	1.10	BYV-L	Very Bouldery & Loamy
1.00	1.10	BYV-LS	Very Bouldery & Loamy Sand
1.00	1.10	BYV-SIL	Very Bouldery & Silt
1.00	1.10	BYV-SL	Very Bouldery & Sandy Loam
1.00	1.30	BYX	Extremely Bouldery
1.00	1.30	BYX-FSL	Extremely Bouldery & Fine Sandy Loam
1.00	1.30	BYX-L	Extremely Bouldery & Loamy
1.00	1.30	BYX-SIL	Extremely Bouldery & Silt Loam
1.00	1.30	BYX-SL	Extremely Bouldery & Sandy Loam
1.00	1.00	C	Clay
1.00	1.00	CB	Cobbly
1.00	1.00	CB-C	Cobbly & Clay
1.00	1.00	CB-CL	Cobbly & Clay Loam
1.00	1.00	CB-COSL	Cobbly & Coarse Sandy Loam
1.00	1.10	CB-FS	Cobbly & Fine Sand
1.00	1.10	CB-FSL	Cobbly & Fine Sandy Loam
1.00	1.00	CB-L	Cobbly & Loamy
1.00	1.00	CB-LCOS	Cobbly & Loamy Coarse Sand
1.00	1.00	CB-LS	Cobbly & Loamy Sand
1.00	1.10	CB-S	Cobbly & Sand
1.00	1.00	CB-SCL	Cobbly & Sandy Clay Loam
1.00	1.00	CB-SICL	Cobbly & Silty Clay Loam
1.00	1.00	CB-SIL	Cobbly & Silt Loam
1.00	1.10	CB-SL	Cobbly & Sandy Loam
1.00	1.00	CBA	Angular Cobbly
1.00	1.10	CBA-FSL	Angular Cobbly & Fine Sandy Loam
1.00	1.20	CBV	Very Cobbly
1.00	1.20	CBV-C	Very Cobbly & Clay